PATENT SPECIFICATION

713,472

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COMPLETE SPECIFICATION

Improvements in or relating to Method of Making a Nut Blank

We, THE WATERBURY FARREL FOUNDRY AND MACHINE COMPANY, a Corporation organised under the Laws of the State of Connecticut, United States of America, of 453, Bank Street, Waterbury, Connecticut, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method of, and machine for, making nut blanks and relates particularly to the making of such nuts by cold-forging operations in a plurality of steps, or progressively, at separate stations in the same machine. As illustrated, it is possible according to the invention with some changes in the tools, i.e., the dies and punches, to make either a nut having a washer face upon one surface and chamfered on the other face or a nut having a plain face at one surface and chamfered at the other.

As illustrated, the method comprises a series of steps consisting of pressing or forming operations, one step in the process being carried out at each of a plurality of stations in the machine, the work piece being transferred from one station to another. The particular transfer means which is employed in the present operation is such that where desired the nut blank may be reversed in position or turned end for end between two successive stations, and when desired may be transferred directly from one station to another without reversal. In other words, we have found that it is desirable at certain of the pressing operations to turn the nut end for end so that the die face of the nut at one operation will become the punch face or punch side of the nut at the next succeeding operation. This is not the case, however, in connection with all of the forming steps in the process, and where it is not desired, the nut is transferred from one station to the next without reversal.

It is also contemplated by the present method to employ wire stock of relatively large diameter compared to the width of the finished blank. As shown, the stock is of circular form in cross section and the finished nut is polygonal or hexagonal in form. It may also be noted that while the finished nut blank is provided with a through opening to receive the internal threads by a piercing operation, the operation is the last to be performed, and that prior to this piercing operation the nut is deeply indented on both sides so that only a small web of metal is left to be punched out by the piercing operation.

Moreover, the operation of the present apparatus and the practice of the present process results in a finished nut having well-formed and clearly-defined faces upon the ends and flat side faces with well-filled and sharply-defined corners without burrs or similar imperfections.

One object of the present invention is to provide a novel method of forming a nut blank from solid stock by cold-forging or pressing operations.

A further object of the invention is to provide a novel method and apparatus for cold forging a polygonal nut blank from solid bar stock with a minimum of operations with comparatively little lateral flow of the metal.

According to the invention there is provided a method of making a polygonal nut blank including cutting a workpiece from a length of solid rod or wire stock and including the following cold-forming steps in the order listed: forming a shallow recess at one end of the workpiece, forming a chamfer at the edge of the other end of the workpiece and simultaneously deepening said recess and slightly compressing the workpiece into shorter and wider shape, after

[Price 2/8] Price 4s 6d

these steps introducing the workpiece into a die having flattened side walls roughly corresponding to the final polygonal shape of the nut blank and forming the workpiece into roughly polygonal shape and simultaneously forming a wide chamfer at the recessed end of the workpiece and an indentation having flared walls at the previously chamfered end of the workpiece, whereafter the nut blank is completed in additional cold-forging steps.

The invention also includes a machine for making a polygonal nut blank including a cutting mechanism for cutting a workpiece from a length of solid rod or wire stock and including several stations for performing cold-forging operations, each station having a co-operating die and punch for performing such operations, said machine comprising the following stations in the order listed: a first station having a punch with a flat cone at its front end adapted to form a shallow recess at one end of the workpiece; a second station having a punch with a cone at its front end, said cone being slightly higher than said first-mentioned cone in order to deepen said shallow recess, said second station also having a die formed to chamfer the edge of the workpiece at the end opposite said one end, said die being slightly wider and shallower than the die at the first station; and a third station having a punch with a reduced and tapered end adapted to form an indentation in one end of said workpiece, the die at that station being shaped to form a wide chamfer at the opposite end of the workpiece and to form the workpiece into rough hexagonal shape, means being provided associated with said second and third stations to turn the workpiece end for end between the operations performed at these two stations.

In order that the invention may be understood, it will now be described with reference to the accompanying drawings in which:

Fig. 1 is a sectional view of the working portion of a nut former or press embodying the invention and designed to carry out the improved process;

Figs. 2 to 5 are sectional views of the tools employed at stations 2, 3, 4 and 5 respectively of the machine shown in Fig. 1 for forming a nut blank having a washer face;

Fig. 6 is a sectional view of the tools shown at station 6 of the machine shown in Fig. 1;

Figs. 7 to 12 show side, end and elevational views of the nut blank at stations 1 to 6 of the machine respectively;

Fig. 12A is a view of the slug expelled from the blank in the piercing operation shown in Fig. 6;

Figs. 13 to 17 are sectional views showing the tools employed at stations 2 to 6 respectively of a nut former similar to that shown in Fig. 1 but which is employed for making a plain-face nut;

Figs. 18 to 22 are elevational and end views respectively of the nut blank formed at stations 2 to 6 respectively of the apparatus equipped with tools shown in Figs. 13 to 17;

Fig. 23 is an elevational view partly in section of the driving mechanism for the transfer apparatus;

Fig. 24 is an elevational view partly in section of the transfer means for transferring the blanks from one station to another;

Figs. 25 to 29 are diagrammatic views showing the position of the transfer apparatus at various stages in the operation of transferring the blank from one station to the next; and

Figs. 25A to 29A are top plan views of the mechanism shown in Figs. 25 to 29 respectively.

To illustrate one embodiment of the invention an apparatus is shown comprising a frame 10 in which is mounted a die block 11 and co-operating with the dies mounted in this block, as will be hereinafter described, is a gate 12 designed to be reciprocated toward and from the die block in the usual manner. The gate carries a plurality of tools to co-operate with the dies in the die block.

At station No. 1 in the die block is mounted a cut-off die 14 having an opening through which is fed a length of stock 15 so that a portion thereof will protrude from the die to be severed by the cut-off knife 16 which is shown diagrammatically, as this is well known in the art. After a short length or work piece, such as the work piece 17 shown in Fig. 7, is cut from the length of stock, this work piece is transferred to the second station of the machine by the knife 16 in the usual manner.

At station No. 2 a die holder 18 is mounted in the die block, the die holder having a recess therein in which is mounted the die 19. Also movably mounted in the holder 18 is the knock-out pin 20, the end of which extends into the opening in the die 19 and assists in the formation of the nut from the work piece. The knock-out pin is actuated by a knock-out rod 21 which may be advanced by suitable mechanism, not shown, and which serves to cause the advance of the knock-out pin to eject the work piece from the die.

The gate at this station is provided with a punch holder 23 which carries a punch 24 which, when the gate is advanced, projects into the die to act upon the work piece. As shown more especially in Fig. 2, the end of the punch 24 is provided with a flat cone 25 to indent or produce a domed recess in the punch face of the blank slightly. The blank, after the operations at this station,

is shown at 26 in Fig. 8 of the drawings, where, as will be seen, it has been squared and is provided with a rear or substantially flat face 27 on the die side of the work piece while on the punch face is a shallow conical indentation 28. The punch 24 pushes the blank out of the knife 16 into the die 19, and the knife dwells in this position until the punch recedes a sufficient distance to permit the knife to return to station 1 for a further operation.

The blank in the form shown in Fig. 8 is then transferred by a suitable mechanism to be hereinafter referred to as station No. 3 of the mechanism. At this station a die 29 is mounted in the die holder 30 carried by the die block 11, the die 29 being provided with an opening within which extends a knock-out pin 31 actuated by a knock-out rod 32. At this station the gate is provided with a punch holder 33 which carries a punch 34, the end of which enters the opening in the die 29 to properly size the nut at this station.

In the enlarged view of Fig. 3 it will be seen that the opening in the die 29 is so shaped at its rear end, as shown at 35, that it provides a chamfer at the rear face of the work piece or blank, which chamfer surrounds a substantially flat rear-end surface formed by the knock-out pin 31. The die opening at this station in which the blank rests is slightly larger than the opening in the die 19 at station No. 2 so that the blank is slightly enlarged as well as being provided with the chamfer on the rear face.

As the gate recedes after the forming operation, the work piece is ejected from the die by the knock-out pin 31, and the form of the blank at this time is shown at 36 in Fig. 9. It will be observed that the rear or die face of the nut has been provided with the chamfer 37 while the punch face is provided with the indentation 38 of substantially the same or slightly greater depth as the indentation 28 made at station No. 2. The punch 34 is coned slightly upon its end as shown at 39 to provide this indentation. The blank at station No. 3 has been sized and slightly enlarged with respect to its diameter at station 2.

When the operations at station No. 3 have been completed and the blank is of the form shown in Fig. 9, it is then transferred to station No. 4. At this time, however, the blank is not only transferred from one station to the next but is also inverted or turned end for end so that the punch face of the blank at station No. 3 becomes the die face of the blank at station No. 4, and the face of the blank provided with the chamfer 37 is operated upon by the punch carried by the gate, as will be hereinafter explained. Station No. 4 may be termed the doming station, and the chamfer 37 at the punch face of the blank at this station allows the doming punch to enter and squeeze the nut to provide a secondary chamfer at the die side of the blank, as will hereafter be explained, without creating a fin at the edge of the blank at its punch face.

At station No. 4 there is a die holder 41 which carries a die 42 within the opening of which is mounted a knock-out pin 43 actuated by a knock-out rod 44 as before. The gate at this station is provided with a punch holder 45 which carries a punch 46. As shown in Fig. 4 of the drawings, the rear end of the die opening is shaped as at 49 to provide a relatively large chamfer at this end of the blank. The die is also provided with flat faces upon its walls to initiate the formation of the hexagonal shape of the finished blank, and likewise the working end of the punch 46 is provided with co-operating flat faces 50. The punch 46 is also provided with a reduced end 51 tapered on its side wall to indent the punch face of the blank.

After the operation has been performed at station No. 4, the blank is ejected from the die and is in the form shown at 52 in Fig. 10. It will be seen that on the die face of the blank is a relatively large chamfered surface 53 and a flat end face 54. Upon the punch side of the blank is a relatively sharp indentation 55 the wall of which has an angle or flare of substantially 30°, as shown at 55*a*. It will be understood that this indentation 55 is at the face of the blank which was previously provided with the chamfer 37 as the blank was inverted or turned end for end between stations 3 and 4, and the chamfer 37 previously provided permits the blank to be upset in this manner without creating fins adjacent the corners 56 between the flattened surfaces 57. It will, of course, be understood that, while the blank is given a roughly hexagonal shape at station No. 4, it is not provided with the sharply defined corners desired in the finished product.

The blank is then transferred to station No. 5, which may be termed the hexing station, and during its transference is again turned through an angle of 180° or inverted so that the chamfered surface 53 of the blank is on the punch face at station 5. At this station a floating die 59 is movably mounted in a die holder 60, the die being urged outwardly by the spring 61. Within the opening of the die 59 are mounted die inserts 62 and 63, the insert 62 being provided with a circular opening to receive punch 64 (Fig. 5) which is provided with a reduced end 65 to indent the rear face of the work piece. The insert 63 is provided with a hexagonal opening 66 designed to receive the blank and the punch which will be hereinafter described. It will be noted that the opening in the insert 62 is slightly smaller

than that in the insert 63 so as to provide a shoulder 67 to form the washer face upon that side of the blank, and the insert 62 is set into the insert 63 to provide the latter with a longer grip upon the die 59.

At this station the gate is provided with a punch holder 68 which carries a hexagonal punch 69 of substantially the shape and size of the dimensions of the finished nut blank so that the blank at this station will be completed in its hexagonal form with sharply-defined corners. This punch is provided with a reduced end 70 to indent the punch face of the blank, and the indentations formed at each face will be relatively deep so that a relatively thin web of metal will remain between the two indentations.

The blank as it appears after the operations are performed at the hexing station No. 5 is shown in Fig. 11 of the drawings as shown at 72. As will be seen, the die face of the blank is provided with a circular flat washer face 73, and the lateral surface of the blank is provided with flat faces 74 having sharply-defined corners 75. At the punch face of the blank is a chamfer 76 adjacent the edge thereof, this chamfer being formed at the face of the blank where the chamfer 53 previously existed. The faces of the blank are deeply indented as shown at 77 and 78 leaving a relatively thin web of metal 79 therebetween.

The blank is now transferred to station No. 6 which is the piercing station. At this station a piercing die 81 is mounted in a die holder 82 and the gate is provided with a piercing punch 83 which, as shown in Fig. 6, is adapted to enter the indentation 78 in the outer or forward face of the blank and eject the web 79 therefrom in the form of a slug 85 shown in Fig. 12A. As the gate recedes, the blank may be stripped from the punch 83 by the usual stripper 87.

The nut is now in the form shown in Fig. 12, the exterior dimensions being substantially the same as those shown in Fig. 11 but the finished blank 88 is now provided with a smooth central opening 89 therethrough to receive the usual threads.

In Figs. 13 to 17 of the drawings, the forming of a plain-face nut by the same machine previously described is illustrated, except for a slight change in the tools employed in the machine. As shown in Fig. 13, the tools employed at the squaring station are the same as those employed in the second station, as shown in Fig. 2. And likewise, as shown in Figs. 14 and 15, the same tools are employed as are used to make the washer-face nut and illustrated in Figs. 3 and 4. These tools have been given the same reference characters as their action upon the blank is the same.

Likewise, the various parts of the blank in Figs. 18, 19 and 20 have been given the same reference characters as the corresponding parts in Figs. 8, 9 and 10, as the same tools have been employed, and the form of the blank is the same as at each of stations 2, 3 and 4.

At station 5, however, the tooling is slightly different in order to so form the nut that its die face is a plain flat face instead of being provided with a washer face, as was previously described in connection with the tooling at station 5, illustrated in Fig. 5. As shown in Fig. 16, the punch which is provided upon the gate is of the same form as the punch 69 shown in Fig. 5, and is also provided with the reduced end 70 to form a deep indentation in the punch face of the blank. A die 91 is mounted in the die block 11, this die being movable with respect to the die block and die holder 60 and forced outwardly by a spring, the arrangement being similar to that shown at station No. 5 in Fig. 1. Also, the punch 92 at this station is provided with a reduced end 93 to indent the rear or die face of the blank. Within the die holder 91 are the die inserts 94 and 94*a*, the insert 94 being provided with a hexagonal die opening 95, which opening is provided with a flat annular end face 96 surrounding the opening through which the punch 92 extends in order to form at this face of the blank a plain flat face surrounding the indentation made by the punch 92. As already explained in connection with Fig. 5, the blank at this station is given its final external form having a true hexagonal outline with sharply defined edges. This is illustrated in Fig. 21 of the drawings, wherein the blank is shown at 97 having a flat rear face 98, flat side faces 99 with sharply defined corners 100 and a chamber 101 at the edge of the punch face. It is provided with relatively deep indentations 102 and 103 leaving a relatively thin web 104 between them.

The blank is now transferred to station No. 6 having the piercing tools shown in Fig. 17 which are in all respects like those previously described in connection with Fig. 6 and the parts of which are given the same numerals. After the piercing operation, the blank is of the form shown at 105 in Fig. 22. It has not been changed so far as its external dimensions are concerned from that shown in Fig. 21, but the web 104 has been ejected from the blank and it is now provided with a smooth central opening 106 to receive the usual threads. The flat face 98 remains as before, as does likewise the chamfer 101.

It will also be understood that the same transfer mechanism is used in making the flat-face nut as was referred to in making the washer-face nut, and which will be later described. With the use of this mechanism, the blank is inverted or turned end for end

between stations 3 and 4 and also between stations 4 and 5.

The transfer mechanism employed in the present apparatus is illustrated and claimed in British Patent Specification No. 671,016, and will, therefore, be described only briefly herein as no claim is made to the mechanism *per se* in the present application.

As shown in Fig. 23, a link 108 adapted to be reciprocated by a moving part of the apparatus (not shown) is connected to a rock arm 109 secured to a short shaft 110 rotatably mounted in the frame of the machine. Upon this shaft 110 is secured a two-part gear consisting of the sections 111 and 112 and the teeth of this gear are in mesh with a pair of pinions 113 and 114 keyed to shafts 115 and 116 rotatably mounted in the frame of the machine. Secured to the shafts 115 and 116 are crank arms 117 and 118 respectively, these arms carrying at their outer ends crank pins 119 and 120 as shown more especially in Fig. 24.

The crank pins 119 and 120 are journalled in a carrier or frame designated generally by the numeral 121 and secured in this frame are a plurality of finger blocks 122, 123, 124 and 125 (Fig. 24). Transfer fingers 126 and 127 are secured to the finger blocks 122 and 125, and are adapted to engage the blanks at station No. 2 and station No. 5 of the machine and transfer the blanks to stations Nos. 3 and 6, respectively, with the blank being held in its original position without being turned or inverted. It may here be noted that when the two-part gear 111 and 112 is oscillated by the link 108 (Fig. 23) the cranks 117 and 118 are also oscillated, effecting the oscillation of the carrier 121 which moves in an arcuate path and moves any points in the carrier substantially through a semi-circular arc. Likewise, the transfer fingers 126 and 127 move in a substantially semi-circular path in their movements from one station to the next and return, this movement being in a plane parallel to the face of the die block or in a vertical plane when the gate operates horizontally as is usual.

The transfer mechanism used in connection with the finger blocks 123 and 124 is arranged to turn the blank end for end or invert it and, as the mechanism is the same at both of these stations, the description of one will suffice. As shown in the section portion of Fig. 24, a shaft 128 is rotatably mounted in the finger block 124 and transfer fingers 129 are secured to the lower end of this shaft. At the upper end of the shaft a collar 130 is fixed thereto, this collar having a pinion 131 formed integrally therewith and also a polygonal portion 132 at its lower end.

A series of racks 133 are mounted on the frame of the machine above the upper ends of the shafts 128, these racks being adapted to co-operate with the pinions 131 to rotate the shafts 128 through an angle of 180° when these shafts are raised to engage the teeth of the pinions 131 with those of the racks 133 and are then moved in a horizontal direction across the racks. During the raising and lowering movement of the shafts 128, the polygonal members 132 co-operate with guide surfaces 134 formed on the frame of the machine to hold the shafts 128 against rotation.

As illustrated in the present machine, and as previously described, the rotatably mounted fingers 129 are employed only between stations 3 and 4 and stations 4 and 5. It will be understood, however, that this rotating finger transfer mechanism may be employed between any two desired stations or omitted between any two desired stations so that the blank may be turned or not as desired. The movement of this rotatable transfer mechanism is shown diagrammatically in Figs. 25 to 29 and may be briefly described as follows:

At the proper time in the operation of the machine the transfer fingers will be engaged with the blank which has been ejected from the die by one of the knock-out pins previously described and is ready to be transferred to the next station. At this time the link 108 will be actuated in one direction effecting partial rotation of the gear member 111 and 112 which will effect partial rotation of the pinions 113 and 114. This will serve to swing the crank members 117 and 118 in a clockwise direction from the position shown in Fig. 24, as shown in Figs. 25 to 29, and will effect corresponding movement of the finger carrier 121.

As the finger carrier moves upwardly from the position shown in Fig. 24, one face of the polygonal member 132 bears against the bearing or guide member 134 so as to prevent rotation of the fingers 129. Toward the end of the upward movement of the carrier 121 of the transfer fingers, the pinion 131 is engaged with the teeth of the rack 133 as shown in Fig. 25. From this point on, the movement of the carrier 121 is largely horizontal, thus progressively moving the parts from the positions shown in Fig. 25 to that shown in Fig. 29 and during this movement the shaft 128 has been rotated through an arc of substantially 180° thus causing the blank to be turned end for end. Continued movement of the crank arms 117 and 118 results in a lowering movement of the carrier 121 until the blank is carried to a position opposite the die opening of the succeeding station of the machine. During this lowering movement the shaft 128 is again prevented from rotation by engagement of the polygonal face 132 with the bearing or guide members 134.

It may here be noted that the guide mem-

bers 134 are spaced apart so that during the rotation of the shaft 128 the polygonal member 132 is out of engagement therewith, thus permitting the turning of the shafts 128.

The path of the blank is shown by the broken lines 135 in Figs. 25 to 29, and it will be understood that the transfer fingers 126 and 127 will also carry the blanks engaged by these fingers along paths of the same form, except that the blank is not turned or inverted.

It will be understood that a double chamfered nut may be made by the same method, the tools at certain stations being modified to form a chamfer on both faces of the blank instead of a flat surface at one face.

What we claim is:—

1. The method of making a polygonal nut blank including cutting a workpiece from a length of solid rod or wire stock and including the following cold-forming steps in the order listed: forming a shallow recess at one end of the workpiece, forming a chamfer at the edge of the other end of the workpiece and simultaneously deepening said recess and slightly compressing the workpiece into shorter and wider shape, after these steps introducing the workpiece into a die having flattened side walls roughly corresponding to the final polygonal shape of the nut blank and forming the workpiece into roughly polygonal shape and simultaneously forming a wide chamfer at the recessed end of the workpiece and an indentation having flared walls at the previously chamfered end of the workpiece, whereafter the nut blank is completed in additional cold-forging steps.

2. The method as claimed in Claim 1, comprising the additional steps of deeply indenting both ends of the workpiece so as to maintain a thin web only, and simultaneously pressing the workpiece into its final hexagonal shape and reducing said wide chamfer to a narrow chamfer, whereafter the workpiece is entirely pierced to form the finished nut blank.

3. A machine for making a polygonal nut blank including a cutting mechanism for cutting a workpiece from a length of solid rod or wire stock and including several stations for performing cold-forging operations, each station having a co-operating die and punch for performing such operations, said machine comprising the following stations in the order listed: a first station having a punch with a flat cone at its front end adapted to form a shallow recess at one end of the workpiece; a second station having a punch with a cone at its front end, said cone being slightly higher than said first-mentioned cone in order to deep said shallow recess, said second station also having a die formed to chamfer the edge of the workpiece at the end opposite said one end, said die being slightly wider and shallower than the die at the first station; and a third station having a punch with a reduced and tapered end adapted to form an indentation in one end of said workpiece, the die at that station being shaped to form a wide chamfer at the opposite end of the workpiece and to form the workpiece into rough hexagonal shape, means being provided associated with said second and third stations to turn the workpiece end for end between the operations performed at these two stations.

4. A machine as claimed in Claim 3, wherein a fourth station is provided subsequent to said third station and means associated with said third and fourth station to turn the workpiece end for end between the operations performed at the third and fourth station, said fourth station having a punch with a relatively long reduced front end, the die at said fourth station being shaped to impart to the workpiece its final hexagonal shape and having an insert with a circular opening through which a counter punch passes, said counter punch having a reduced end adapted to indent the workpiece, said last-mentioned reduced end being surrounded by an annular flat surface on said counter punch end so as to form a flat washer face on the workpiece end, the heights of said reduced ends being such that after the indenting operation a thin web remains in the workpiece.

5. A machine as claimed in Claim 4, wherein means is provided to form a chamfer at the edge of the workpiece on a face thereof opposite the washer face.

6. The method of making a polygonal nut blank substantially as described with reference to the accompanying drawings.

7. A machine for making a polygonal nut blank constructed and adapted to operate substantially as described with reference to the accompanying drawings.

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Fig. 1.

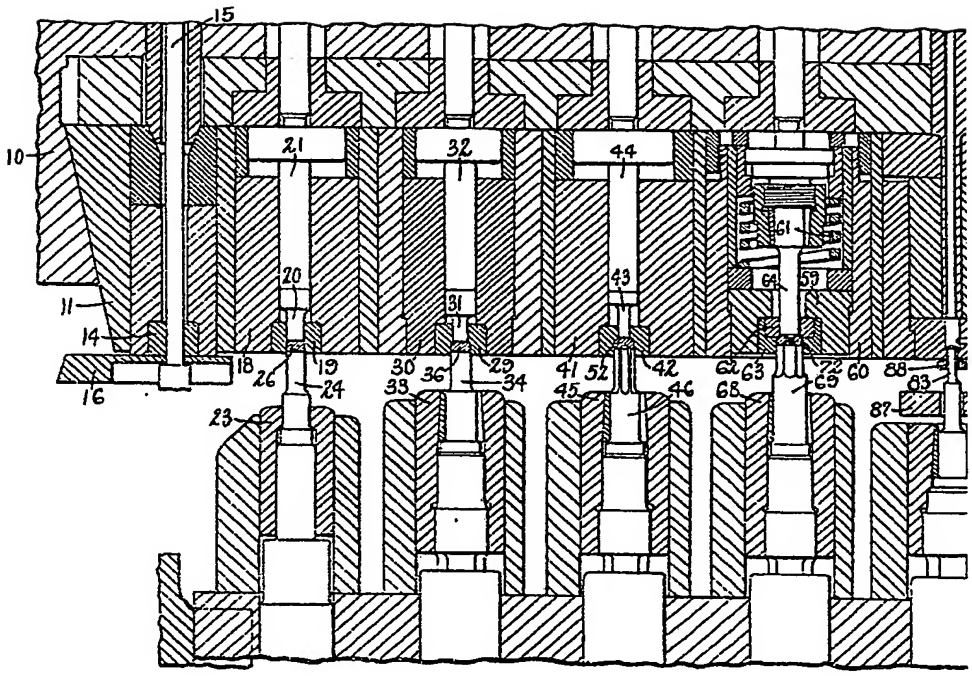


Fig. 2.

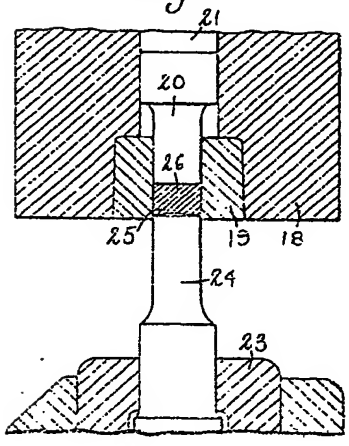
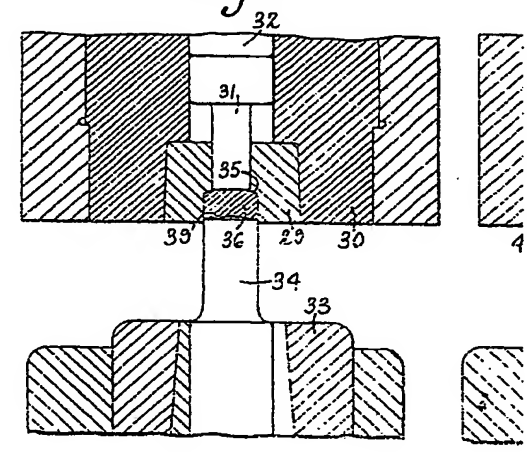


Fig. 3.



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3 SHEETS

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SHEET 1

ig.1.

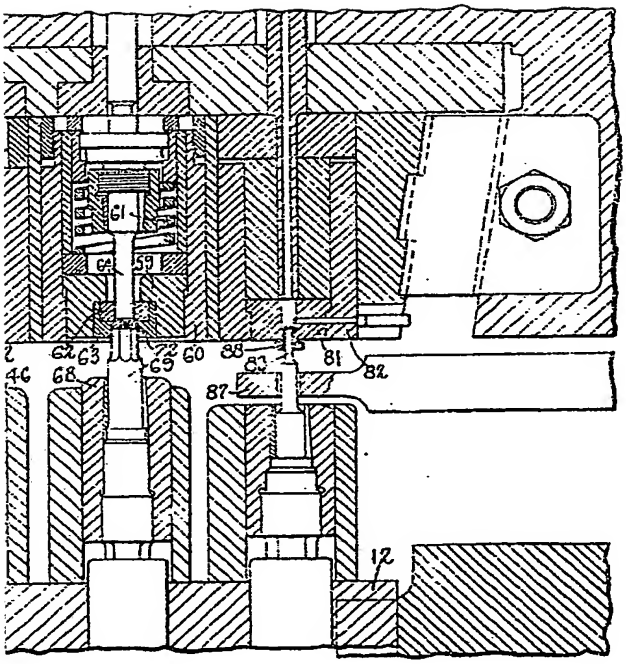
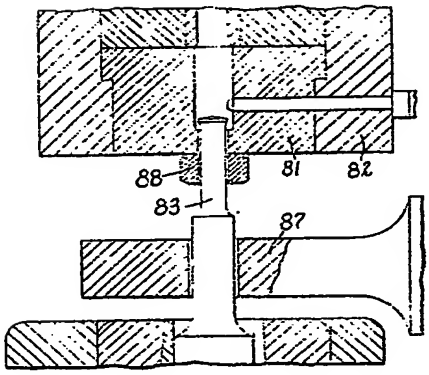


Fig.6.



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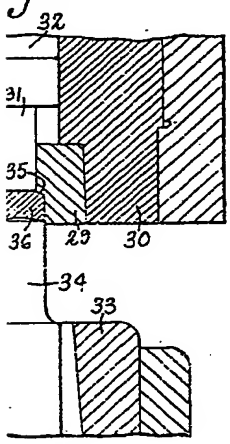


Fig.4.

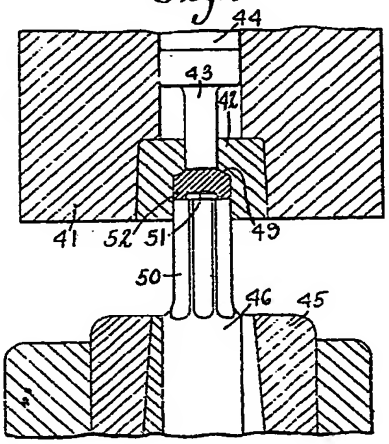
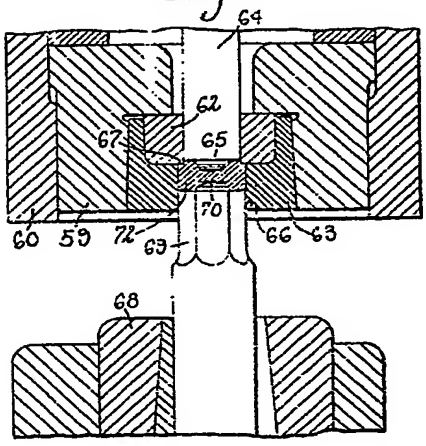


Fig.5.



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3 SHEETS *This drawing is a reproduction of the Original on a reduced scale.*
SHEET 1

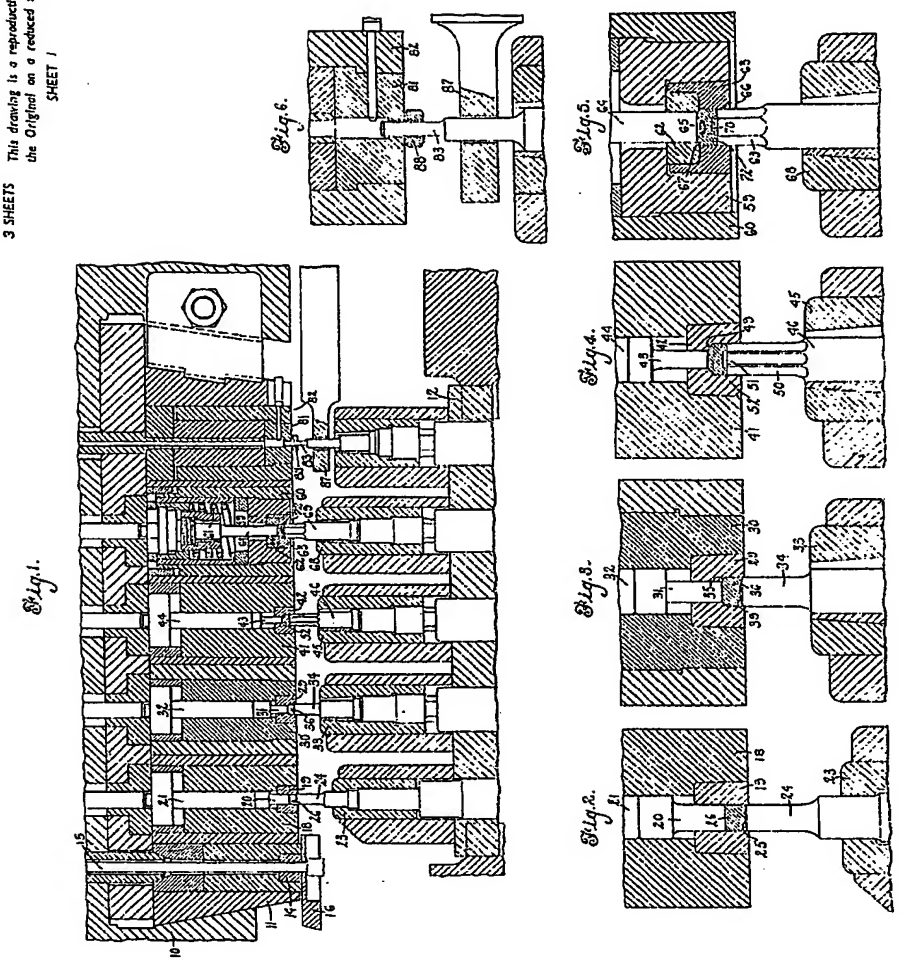


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

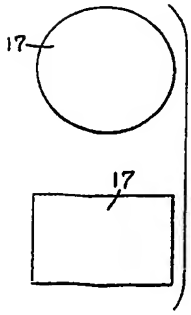


Fig. 8.

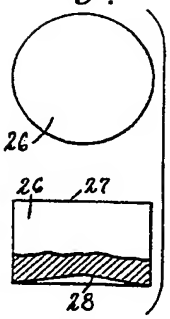


Fig. 9.

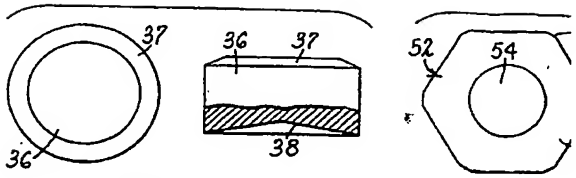


Fig. 11.

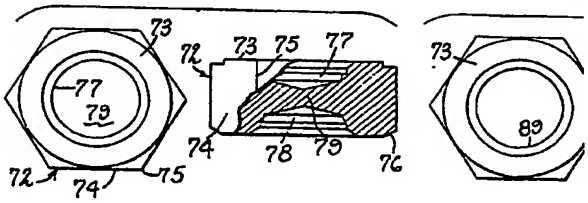
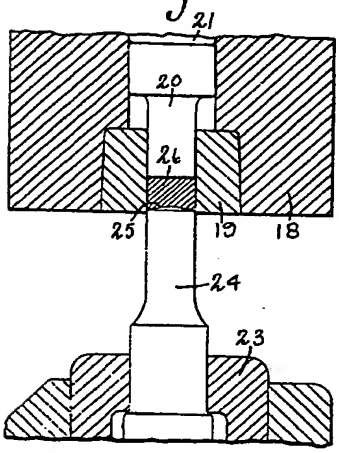


Fig. 12.

Fig. 13.



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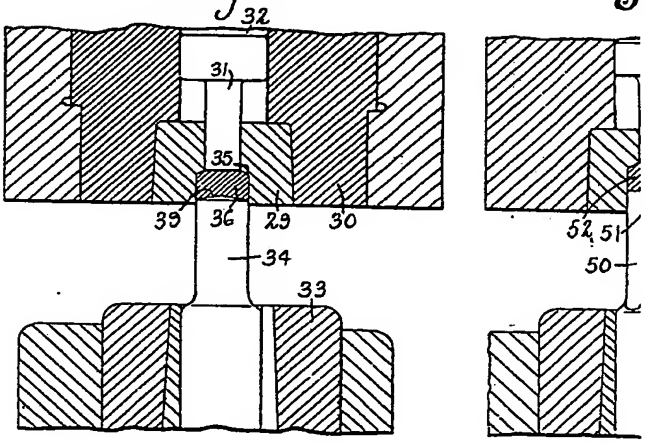

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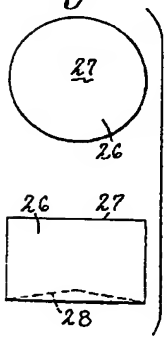

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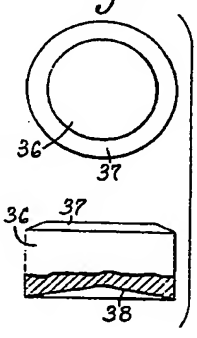

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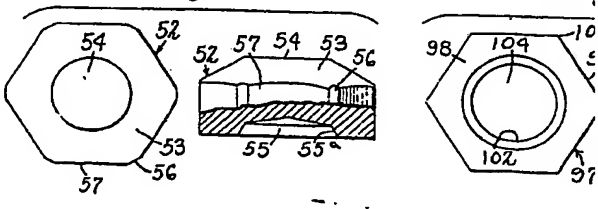

713,472 COMPLETE SPECIFICATION

3 SHEETS

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SHEET 2

Fig.10.

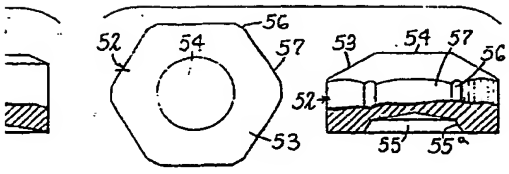


Fig.12.

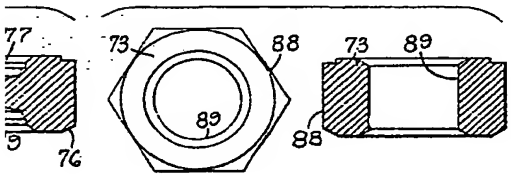


Fig.17.

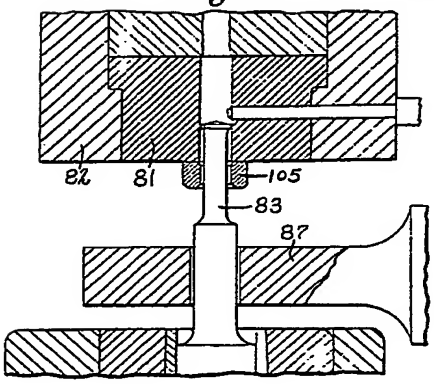
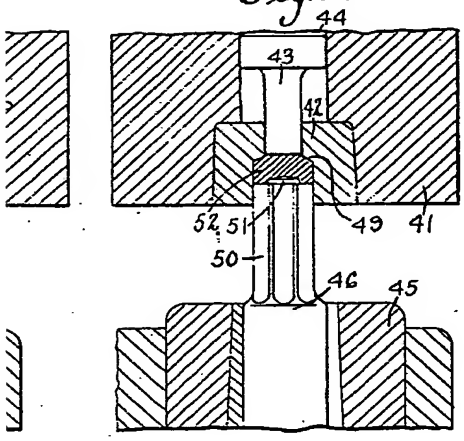


Fig.15.



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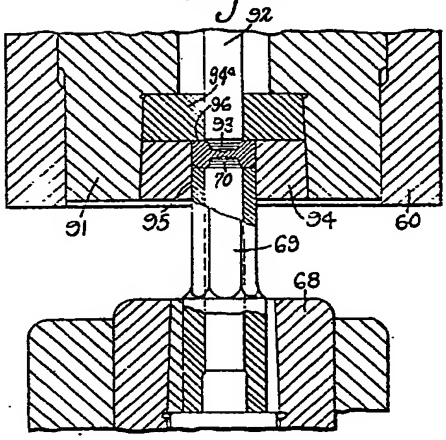

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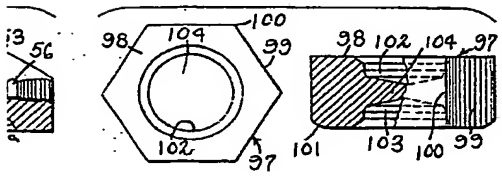

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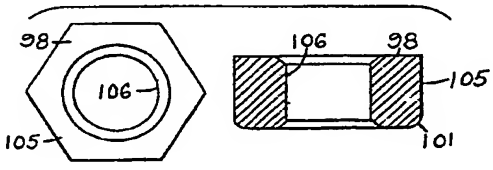

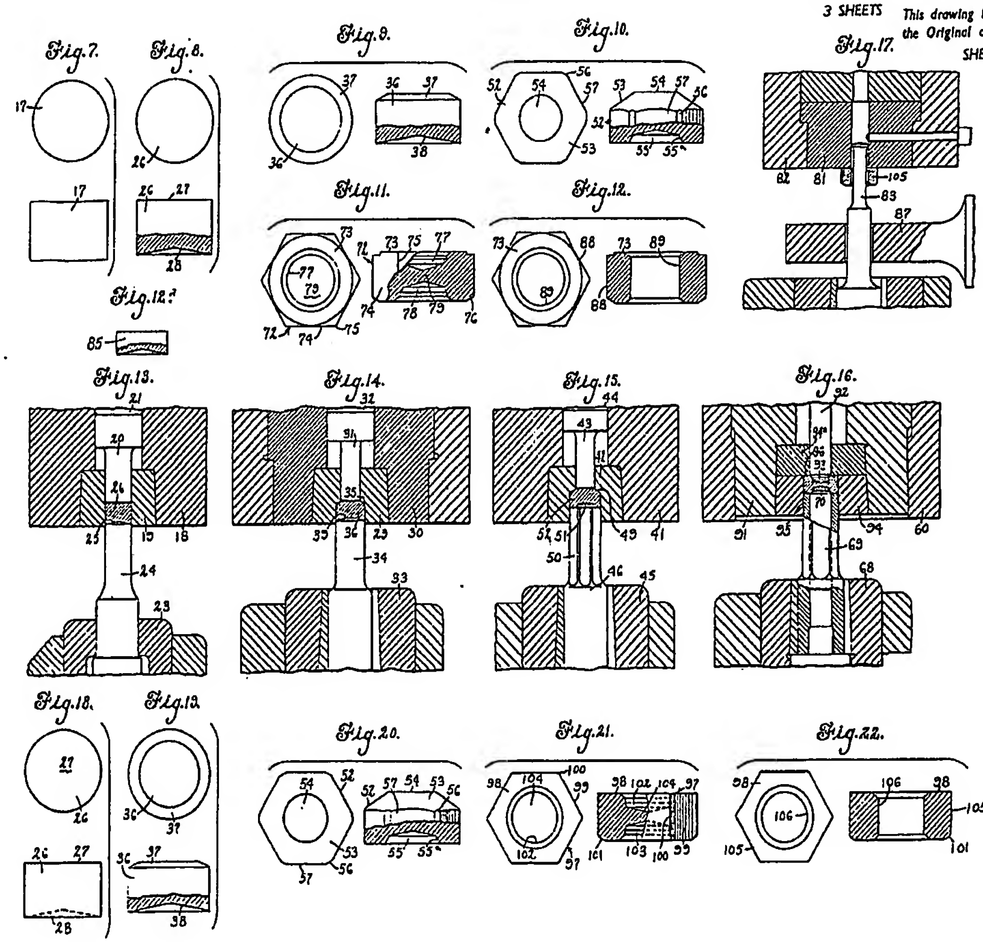

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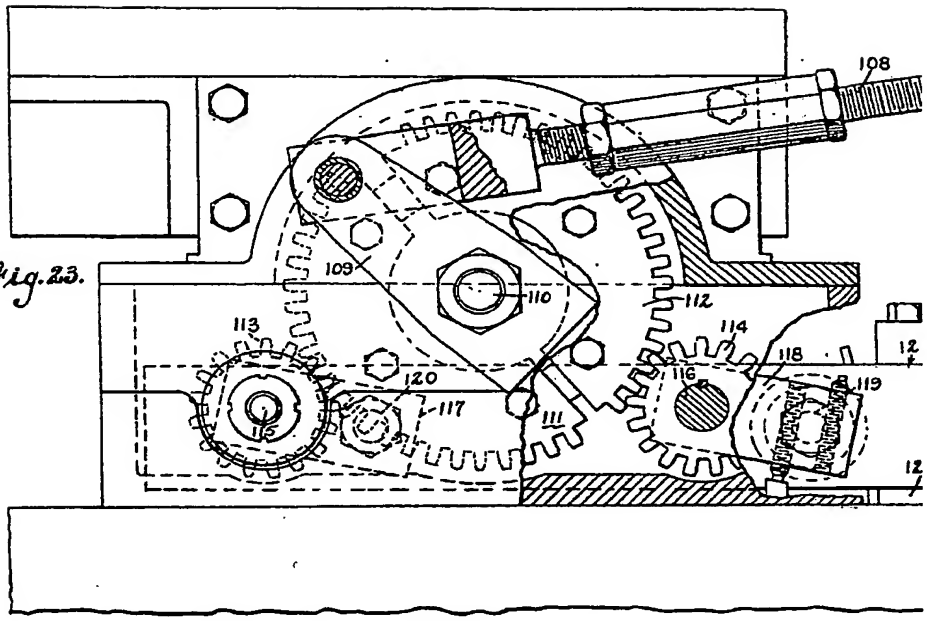

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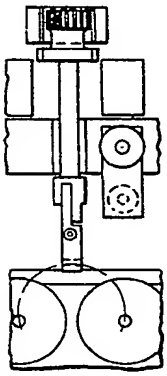

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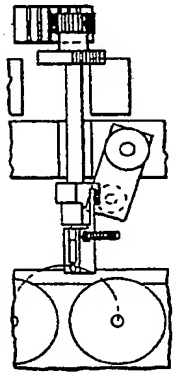

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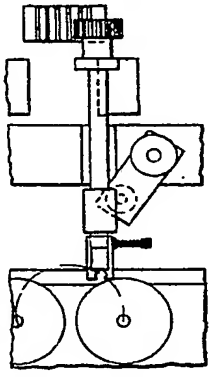

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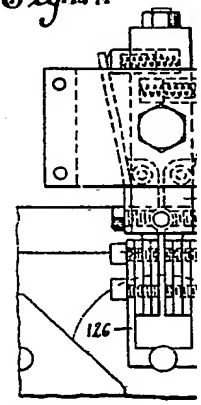
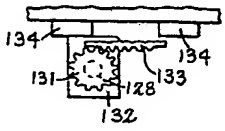


Fig. 25A



713,472 COMPLETE SPECIFICATION

3 SHEETS

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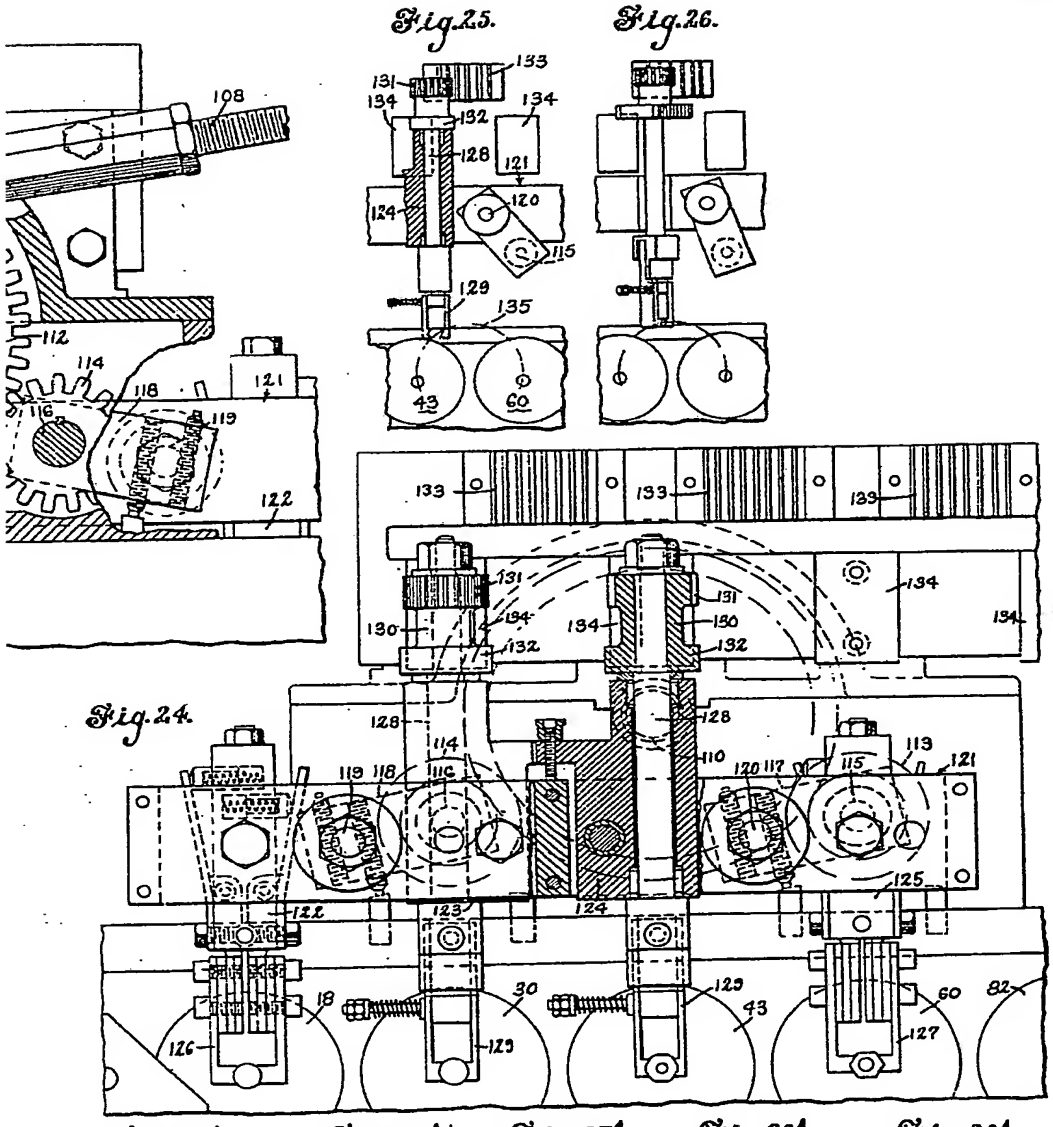
SHEET 3



713,472 COMPLETE SPECIFICATION
3 SHEETS This drawing is a reproduction of the Original on a reduced scale.
SHEET 3

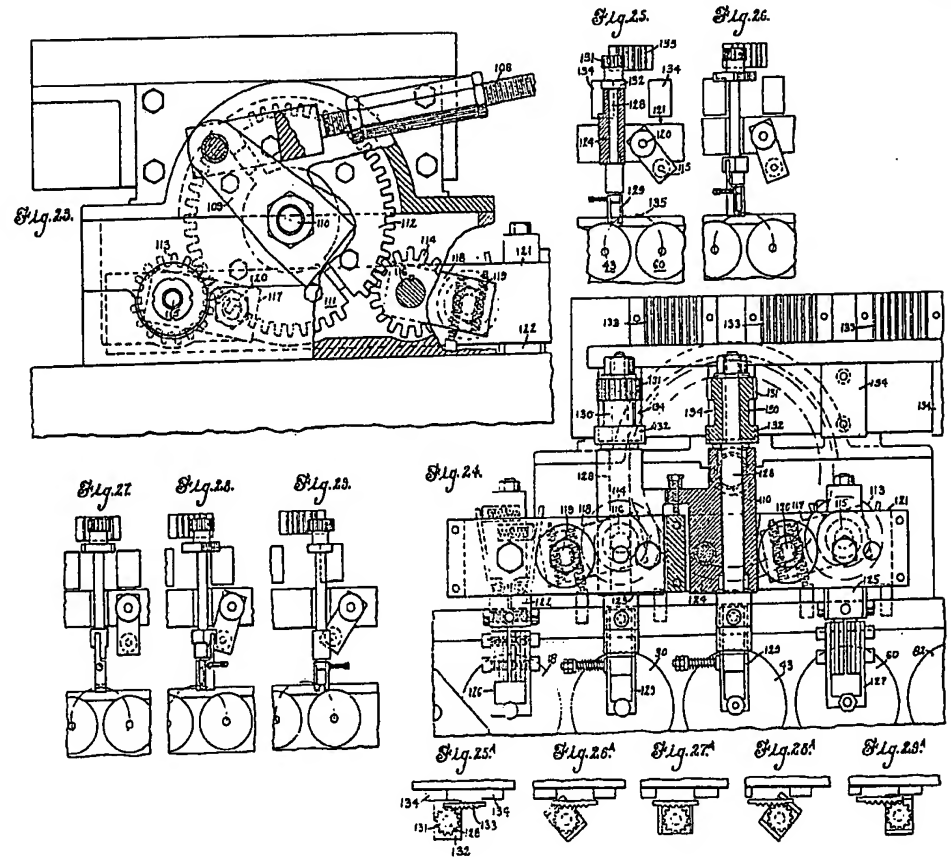


Fig. 23. Fig. 24. Fig. 25. Fig. 26. Fig. 27. Fig. 28. Fig. 29. Fig. 25A Fig. 26A Fig. 27A Fig. 28A Fig. 29A